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Administration**

NAS-IR-43020001
October 30, 1986

Interface Requirements Document



National Airspace Data Interchange Network

X.25 Packet Mode Users

INTERFACE REQUIREMENTS DOCUMENT

A P P R O V A L S I G N A T U R E P A G E

NADIN X.25 Packet Mode Users

APPROVAL SIGNATURES		
PARTICIPANT	NAME	DATE
APM-510		12/19/86
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REVISION RECORD			
REVISION LETTER	DESCRIPTION	DATE	ENTERED BY

EFFECTIVITY	
LOCATION	INTERFACE EFFECTIVITY DATE
Albuquerque ACF Albuquerque, NM	
Atlanta ACF Hampton, GA	
Atlanta NAWPF Hampton, GA	
Atlantic City RDCC Atlantic City, NJ	
Atlantic City SSCC Atlantic City, NJ	
Boston ACF Nashua, NH	
Chicago ACF Aurora, IL	
Cleveland ACF Oberlin, OH	
Denver ACF Longmont, CO	
Fort Worth ACF Euless, TX	
Houston ACF Houston, TX	
Indianapolis ACF Indianapolis, IN	Effectivity date will be
Jacksonville ACF Hillard, FL	the date of the operational
Kansas City ACF Olathe, KS	readiness demonstration of
Long Island (New	the NADIN PSN.
York TRACON) ACF Jamaica, NY	
Los Angeles ACF Palmdale, CA	
Memphis ACF Memphis, TN	
Miami ACF Miami, FL	
Minneapolis ACF Farmington, MN	
New York ACF Ronkonkoma, NY	
Oakland ACF Fremont, CA	
Oklahoma City FAA Academy Oklahoma City, OK	
Salt Lake City ACF Salt Lake City, UT	
Salt Lake City NAWPF Salt Lake City, UT	
Seattle ACF Seattle, WA	
Washington ACF Leesburg, VA	
NOTE: Users can be remote from switching site	

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1. SCOPE

1.1 Scope. This document defines the requirements necessary to provide a packet mode interface between National Airspace Data Interchange Network (NADIN) Packet Switched Network (PSN) and users of packet switched services. The functional requirements of this Interface Requirements Document (IRD) address the lower three layers of the seven layer International Organization for Standardization (ISO) 7498 model. Interface requirements in this IRD are based on the International Telegraph and Telephone Consultative Committee (CCITT) Recommendation X.25, 1984 version.

1.2 Subsystem/equipment item responsibility list. This is a standard IRD and is applicable to any subsystem which has a requirement to transfer data via the NADIN PSN using CCITT Recommendation X.25 protocol.

2. APPLICABLE DOCUMENTS

2.1 Government documents. Unless otherwise specified, the following documents of the issue in effect on the date of this IRD, form a part of this IRD to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this IRD, the contents of this IRD shall be considered a superseding requirement.

SPECIFICATIONS:

Federal Aviation Administration

FAA-E-2770

NADIN Packet Switched Network (PSN)
Functional Specification

FAA-G-2100

Electronic Equipment, General
Requirements

STANDARDS:

Federal

FED-STD-1020
FIRMR 201-8.112-11)

Electrical Characteristics of Balanced
Voltage Digital Interface Circuits

FED-STD-1030
(FIRMR 201-8.112-14)

Electrical Characteristics of
Unbalanced Voltage Digital Interface
circuits

FED-STD-1032

Telecommunications: High speed 25
position Interface for Data Terminal
Equipment (DTE) and Data
Circuit-Terminating Equipment (DCE)

Federal Aviation Administration

FAA-STD-020

Transient Protection, Grounding and
Shielding Requirements for equipment.

OTHER PUBLICATIONS

FCC Rules, Part 15, Subpart J Code of Federal Telecommunications
Regulations

Copies of specifications, standards, drawings, and publications required by suppliers in connection with specified procurement functions should be obtained from the procuring activity or as directed by the contracting officer.

2.2 Non-Government documents. Unless otherwise specified, the following documents of the issue in effect on the date of this IRD, form a part of this IRD to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this IRD, the contents of this IRD shall be considered a superseding requirement.

International Telegraph and Telephone Consultative Committee (CCITT)

- | | |
|----------------------------|---|
| Recommendation X.21bis | Use on public data networks of data terminal equipment (DTE) which is designed for interfacing to synchronous V-series modems. |
| Recommendation X.25 - 1984 | Interface between Data Terminal Equipment (DTE) and Data Circuit Terminating Equipment (DCE) for Terminals Operating in the Packet Mode on Public Data Networks (PDN) |
| Recommendation X.121 | International Numbering Plan For Public Data Networks |
| Recommendation V.35 | Data Transmission of 56 Kb/s using 60-108 KHZ Group Band Circuits. |

Electronic Industries Association (EIA)

- | | |
|-------------|---|
| Bulletin 12 | Application Notes on Interconnection Between Interface Circuits Using RS-449 and RS-232 |
| EIA-530 | High speed 25-position interface for DTE and DCE |
| RS-232 | Interface between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange |
| RS-422 | Electrical Characteristics of Balanced Voltage Digital Interface Circuits. |
| RS-423 | Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits |
| RS-449 | General Purpose 37-Position and 9-Position Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment |

International Organization for Standardization (ISO)

- | | |
|----------|---|
| ISO 2110 | Data Communication 25-Pin DTE/DCE Interface Connector and Pin Assignments |
|----------|---|

ISO 2593	Connector pin allocations for Use with High Speed Data Terminal Equipment
ISO 4902	Data Communication 37-Pin DTE/DCE Interface Connector and Pin Assignments
ISO 7498	Information Processing System Open Systems Interconnection - Basic Reference Model

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.

2.3 Related IRDs.

The following IRDs are related to this IRD.

NAS-IR-21024302	NADIN Packet Switched Network (PSN)/Local Communications Network (LCN) Gateway
NAS-IR-43014302	NADIN PSN GATEWAY/NADIN Message Switched Network (MSN)

3. INTERFACE REQUIREMENTS

3.1 General requirements. This interface shall not degrade the availability and/or reliability of the user subsystem/equipment or the NADIN PSN. The requirements of FAA-G-2100 shall not be applied to commercial, off-the-shelf equipment except when specified.

3.2 Functional requirements. The functional architecture of the NADIN PSN shall be as shown in Figure 1. The relationship of the services provided and the lower three layers of the ISO/7498 model shall be as is shown in Figure 2.

3.2.1 Application layer. Not applicable.

3.2.2 Presentation layer. Not applicable.

3.2.3 Session layer. Not applicable.

3.2.4 Transport layer. Not applicable.

3.2.5 Network layer. This layer defines the procedures for establishing, maintaining, and clearing of the network connection by means of transferring packets across the Data Terminal Equipment/Data Circuit Terminating Equipment (DTE/DCE) interface. This layer shall provide data routing, circuit multiplexing, flow control, and error recovery for packets transmitted across the DTE/DCE interface. Each packet shall be contained in the information field of an information frame (I-frame) at the DTE/DCE data link level interface.

3.2.5.1 Protocol. The network layer protocol shall be in accordance with the CCITT Recommendation X.25 packet level interface. The following sections discuss the specific requirements of the interface, the optional facilities, and the system parameters that are supported by the NADIN PSN interface.

3.2.5.2 Addressing. Each user (DTE) shall be assigned unique network address(es). The address shall be configured according to CCITT Recommendation X.121. The maximum address length shall be no more than 15 decimal digits.

3.2.5.3 Virtual circuit services. The NADIN PSN interface shall support both virtual call (VC) services and permanent virtual call (PVC) services as specified in Section 4.0, CCITT Recommendation X.25.

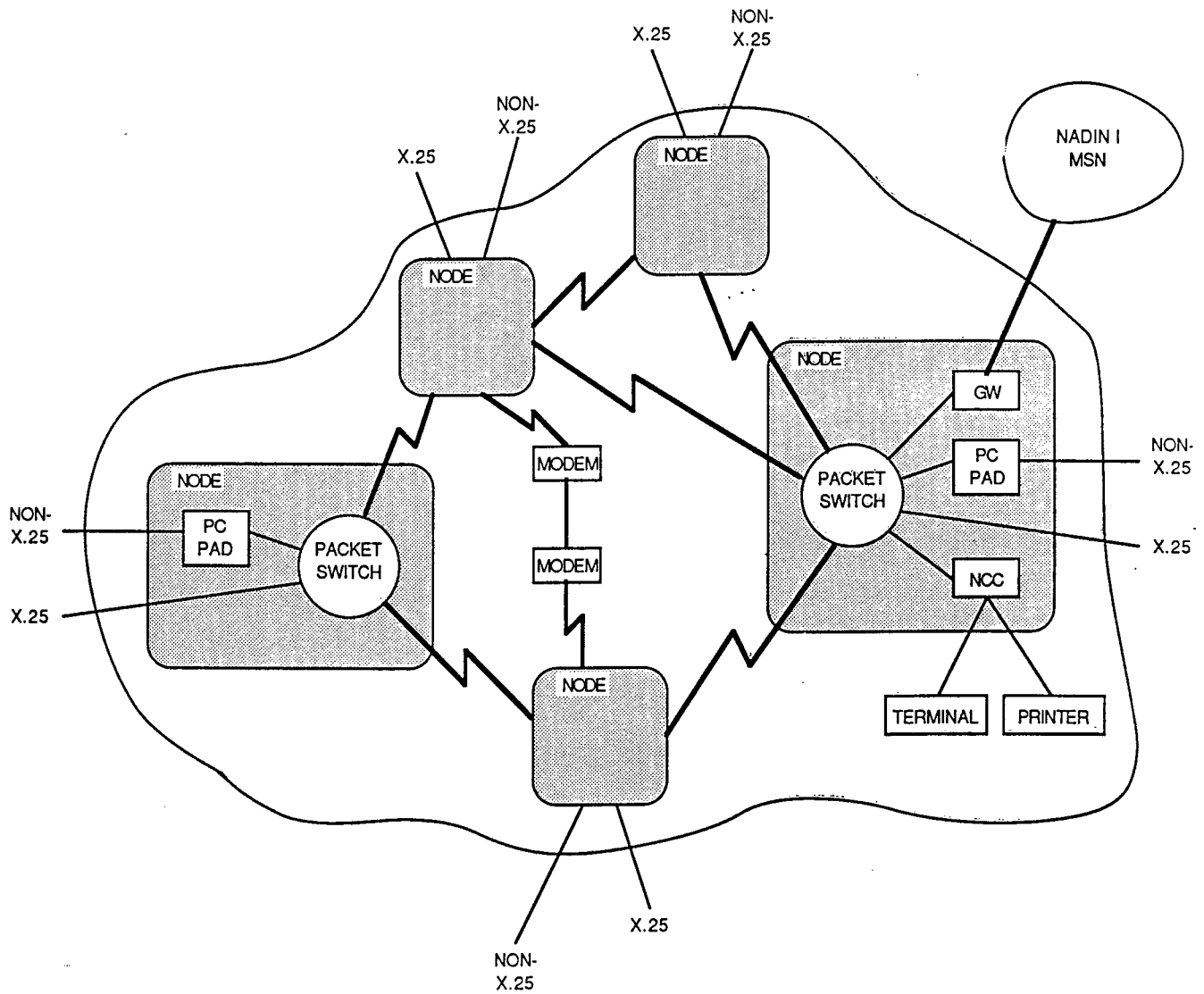


Figure 1. NADIN PSN Functional Architecture

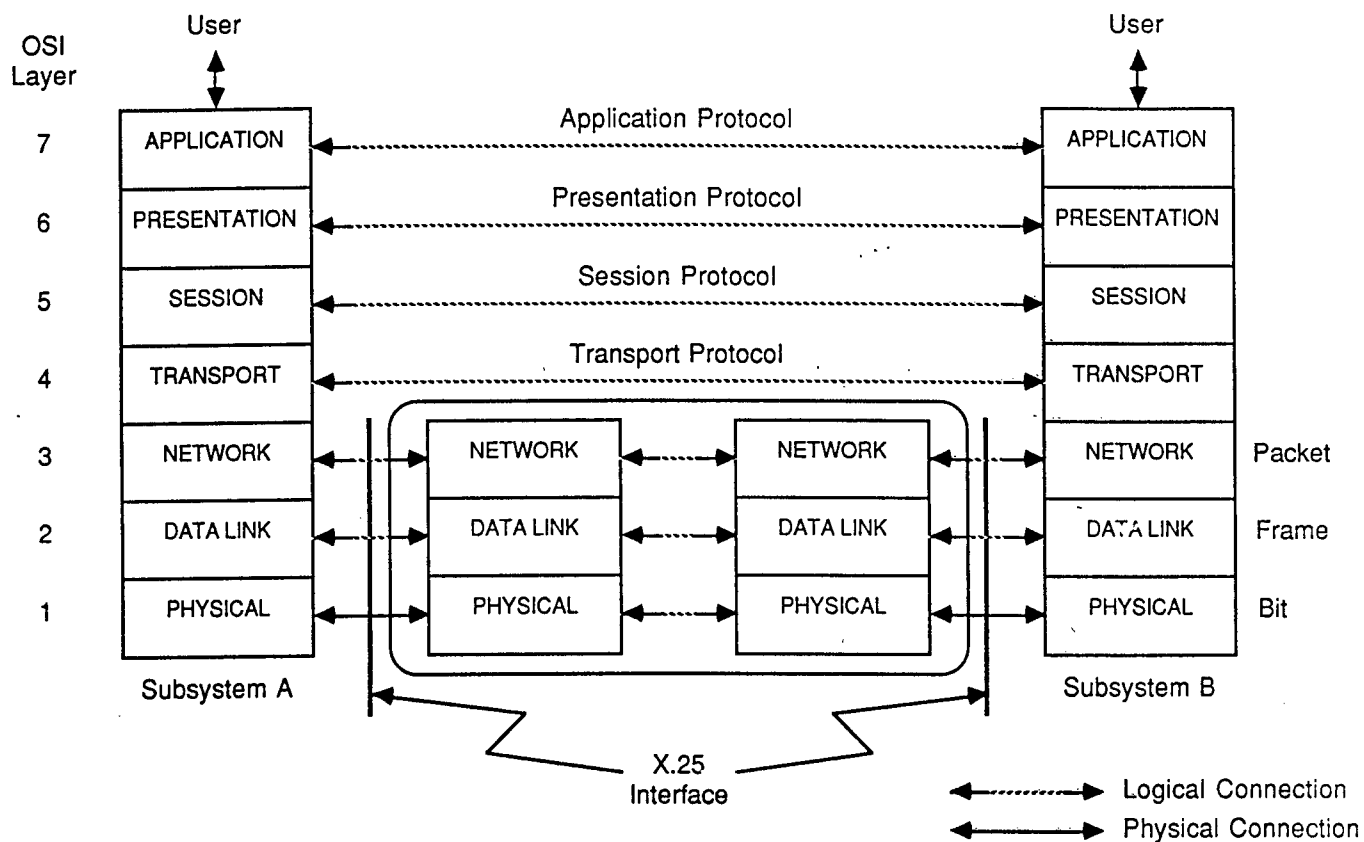


Figure 2. ISO/OSI Model

3.2.5.4 Packet format. The NADIN PSN interface shall support all standard packets as described in CCITT Recommendation X.25 for virtual circuit service.

3.2.5.5 Procedure for optional user facilities (packet level). The NADIN PSN interface shall support all optional user facilities as described in section 6.0, CCITT Recommendation X.25.

3.2.5.6 Packet level parameters. The following packet level parameters shall be supported by the NADIN PSN interface. Specific values shall be set at the time of operation.

- (a) Nonstandard default window size. The flow control window size, in packets, shall be set table over the range of 2 to 127 in steps of 1. An initial setting of 4 shall be made.
- (b) Nonstandard default packet size. The maximum size of the user data field, in octets, shall be set table to 32, 64, 128, 256, and 512. An initial setting of 256 octets shall be made.
- (c) Timers T10, T11, T12, T13, T20, T21, T22, and T23. Timers for DCE time-outs (T10, T11, T12, and T13) and DTE time-limits (T20, T21, T22 and T23) shall be specified according to Annex D of CCITT Recommendation X.25.

3.2.5.7 Gateway services. Users with a requirement to communicate between the NADIN PSN and MSN via the gateway shall use procedures specified in CCITT Recommendation X.25 and additional procedures specified in FAA-E-2770, Appendix VI.

3.2.6 Data link layer.

3.2.6.1 Protocol. The Link Access Procedure for Balanced operation (LAPB) included in the CCITT Recommendation X.25 shall be used as the link level protocol between each user (DTE) and the collocated NADIN packet switch (DCE).

3.2.6.2 Multi-link procedures. The NADIN PSN interface shall support multi-link procedures as subscription time option to distribute the packets across the DTE/DCE, over one or more single-link procedures, and to resequence the packets received from these links for delivery to the DTE or DCE packet level, respectively. These procedures shall be as described in CCITT Recommendation X.25.

3.2.6.3 Link control functions. NADIN PSN shall support LAPB for a variety of control functions. These are defined as a series of command and response frames. These commands and responses shall be as described in Section 2.0, CCITT Recommendation X.25.

3.2.6.4 Frame structure. Frame structure shall be in accordance with section 2.2, CCITT Recommendation X.25.

3.2.6.5 Link parameters. The link parameters and variables are specified in Table I. (See 6.1.11)

Table I. Link Parameter Values

Parameter	Lower Limit	Upper Limit	Increment	Initial Setting
T1 for (I Frame) (seconds)	0	90	0.1	3
T2 (seconds)	0	90	0.1	2.1
N1 (bits)	312	4,152	8	2,104
N2 (tries)	1	127	1	5
T3 (seconds)	0	180	0.1	25
K (Modulo 8)	1	7	1	7
K (Modulo 128)	1	127	1	10

3.2.7 Physical layer. The physical layer shall conform to CCITT Recommendation X.21 bis and provides the mechanical and electrical interface between the network processing components and the communications circuits and equipment. The physical layer shall provide for bit serial communications signals with the correct electrical and timing characteristics. It shall also provide the timing and control signals necessary to synchronize the data signals and to control both the terminal and communications equipment as specified in 3.3.1 and 3.3.2 of this IRD. The NADIN PSN shall support line speeds of 2.4, 9.6, 19.2, 56 and 64 kb/s.

3.2.7.1 Electrical interface. Circuit interfacing between the RS-449 and RS-232 shall be in accordance with EIA Bulletin 12.

3.3 Physical requirements.

3.3.1 Mechanical requirements. The user (DTE) connectors shall have male contacts and a female shell. The NADIN PSN (DCE) shall have female contacts and a male shell as specified in either ISO 2110 for RS-232 or RS-449 for RS-422/RS-423 or EIA-530.

3.3.1.1 Installation. Not applicable.

3.3.1.1.1 Interchangeability. Interface equipment components which perform similar or identical functions shall be interchangeable, and that of the same model and revision number.

3.3.1.1.2 Surface finish. Surface finish shall be as specified in FAA-G-2100.

3.3.1.1.3 Location and orientation. The location of the interface shall be oriented to enable unobstructed access for servicing.

3.3.1.1.4 Holes. Not applicable.

3.3.1.1.5 Fasteners. Fastener hardware shall be as specified in FAA-G-2100. This requirements shall be applied to commercial, off-the-shelf equipment. All male and female connectors shall be provided with captive jack screw fasteners for mating.

3.3.1.1.6 Bonding. Bonding shall be as specified in FAA-STD-020.

3.3.1.1.7 Weight and center of gravity. Not applicable.

3.3.1.1.8 Materials. Materials shall be as specified in FAA-G-2100.

3.3.1.1.9 Markings. Markings shall be as specified in FAA-G-2100. This requirement shall be applied to commercial, off-the-shelf equipment.

3.3.1.2 Connectors. Electrical connectors shall be in accordance with ISO 2110, ISO 4902 and EIA-530.

3.3.1.3 Fluids (gases and liquids). Not applicable.

3.3.1.4 Transportation and handling. Not applicable.

3.3.2 Electrical/Electronic requirements. Pin configuration and electrical characteristics for all signalling equipment shall be in accordance with CCITT Recommendation V.35, RS-232, FED-STD-1030 for RS-423 or FED-STD-1020 for RS-422 or FED-STD-1032 for EIA-530.

3.3.2.1 Electrical/Electronics block diagrams. Electrical/electronic block diagrams are not used to impose requirements in this IRD.

3.3.2.2 System description. System descriptions are not used to impose requirements in this IRD.

3.3.2.3 Schematics. Schematics are not used to impose requirements in this IRD.

3.3.2.4 Interface wiring diagrams. Interface wiring diagrams are not used to impose requirements in this IRD.

3.3.2.5 Power capacity. Not applicable.

3.3.3 Environmental requirements.

3.3.3.1 Thermal requirements. The interface shall perform in accordance with the requirements specified herein throughout a temperature range of 10 to 40 degrees Celsius.

3.3.3.1.1 Passive heat transfer. No passive heat transfer requirements are imposed by this IRD.

3.3.3.1.2 Cooling. No cooling requirements are imposed by this IRD.

3.3.3.2 Electromagnetic. Shielding and grounding for reducing electromagnetic interference shall comply with the requirements in FAA-STD-020. Electromagnetic compatibility shall comply with the requirements in FAA-G-2100 and FCC Part 15, Subpart J.

3.3.3.3 Dynamic. Not applicable.

3.3.4 Envelope requirements. Not applicable.

4. QUALITY ASSURANCE PROVISIONS

4.1 General. Interface requirements imposed by section 3 of this IRD shall be verified by use of the verification methods specified in section 4.4 and at the verification levels (phases) specified in section 4.5. Verification methods and levels shall be applied in accordance with Table II, Verification Requirements Traceability Matrix (VRTM).

4.2 Responsibility for verification. The NADIN X.25 packet mode users have the prime responsibility for Interface Requirements verification. The APM-510 NADIN project manager will support the users in this effort.

4.3 Special test support requirements. This IRD imposes no special test support requirements.

4.4 Verification methods and rationale. Methods of verification selected for use in this IRD are: Analysis (A), Test (T), Inspection (I), and Demonstration (D). Definitions of these verification methods are presented in section 6.0 of this IRD.

Selection of the verification methods used in this IRD was based on the following rationale:

Where practical, all requirements imposed by this IRD are verified by Test. Verification by Test provides a consistent measure of the fulfillment of technical interface requirements. Where Test was not practical, other methods of verification were evaluated and the method(s) which provided the most effective evaluation were chosen. In all cases, verification of each requirement is conducted at the lowest possible verification level.

4.5 Verification phases. At a minimum, one of the three levels of verification shall be performed to demonstrate that all interface requirements have been met. The three levels of verification are Subsystem, Integration, and Site. Definitions of the three verification levels are presented in section 6 of this IRD.

4.6 Quality conformance inspections. The VRTM presented in Table II lists the requirements to be verified, the phase or levels at which verification will occur, and the methods of verification that will be used. Compliance with interface requirements will be evaluated in terms of the VRTM.

4.7 Verification requirements. There are no additional verification requirements imposed by this IRD.

Table II. Verification Requirements Traceability Matrix

X = Not Applicable I = Inspection D = Demonstration T = Test A = Analysis

Section 3 Requirements Paragraph Reference	Verification Phase and Method			Remarks
	Subsys Accept Testing	System Integration Testing	Site Accept Testing	
3.1 General requirements				Description
3.2 Functional requirements				Description
3.2.1 Application layer	X	X	X	
3.2.2 Presentation layer	X	X	X	
3.2.3 Session layer	X	X	X	
3.2.4 Transport layer	X	X	X	
3.2.5 Network layer	T	T	X	
3.2.5.1 Protocol	T	T	D	
3.2.5.2 Addressing	T	T	D	
3.2.5.3 Virtual circuit services	T	T	D	
3.2.5.4 Packet Format	T	T	D	
3.2.5.5 Procedures for optional user facilities (packet level)	T	T	D	
3.2.5.6 Packet level parameters	T	T	D	
3.2.6 Data link layer				Title
3.2.6.1 Protocol	T	T	D	
3.2.6.2 Multi-link procedures	T	T	D	
3.2.6.3 Link control functions	T	T	X	
3.2.6.4 Frame structure	T	T	X	
3.2.6.5 Link parameters				Description
3.2.7 Physical layer	T	T	X	
3.2.7.1 Electrical interface	T	T	X	
3.3 Physical requirements				Title
3.3.1 Mechanical requirements	I	I	I	
3.3.1.1 Installation	I	I	I	
3.3.1.1.1 Interchangeability	D	D	X	
3.3.1.1.2 Surface finish	I	I	I	
3.3.1.1.3 Location and orientation	I	I	I	
3.3.1.1.4 Holes	X	X	X	
3.3.1.1.5 Fasteners	I	I	I	
3.3.1.1.6 Bonding	T-I	T-I	T-I	
3.3.1.1.7 Weight and center of gravity (cg)	X	X	X	

Table II. Verification Requirements Traceability Matrix (Cont)

X = Not Applicable I = Inspection D = Demonstration T = Test A = Analysis

Section 3 Requirements Paragraph Reference	Verification Phase and Method			Remarks
	Subsys Accept Testing	System Integration Testing	Site Accept Testing	
3.3.1.1.8 Materials	I	I	I	
3.3.1.1.9 Markings	I	I	I	
3.3.1.2 Connectors	I	I	I	
3.3.1.3 Fluids (gases and liquids)	X	X	X	
3.3.1.4 Transportation and handling	X	X	X	
3.3.2 Electrical/electronic requirements	T	T	T	
3.3.2.1 Electrical/electronic block diagrams	X	X	X	
3.3.2.2 System description	X	X	X	
3.3.2.3 Schematics	X	X	X	
3.3.2.3 Interface wiring diagrams	X	X	X	
3.3.2.5 Power capacity	X	X	X	
3.3.3 Environmental requirements				Title
3.3.3.1 Thermal requirements	A	X	X	
3.3.3.1.1 Passive heat transfer	X	X	X	
3.3.3.1.2 Cooling	X	X	X	
3.3.3.2 Electromagnetic	T	T	X	
3.3.3.3 Dynamic	X	X	X	
3.3.4 Envelope requirements	X	X	X	

5. PREPARATION FOR DELIVERY

This section is not applicable to this document.

6. NOTES

6.1 Definitions.

6.1.1 Analysis. This method of verification consists of comparing hardware or software design with known scientific and technical principles, procedures, and practices to estimate the capability of the proposed design to meet the mission and system requirements.

6.1.2 Application process. A logical element within a subsystem which performs the information processing required for a specific set of user's requirements.

6.1.3 Demonstration. Demonstration is a method of verification where qualitative determination of properties is made for an end item, including software and/or the use of technical data and documentation. The items being verified are observed, but not quantitatively measured, in a dynamic state.

6.1.4 End User. Two NAS subsystems that communicate via NADIN PSN

6.1.5 Equipment item. Identifiable piece of hardware and/or software which can be bounded with specification and interface definitions.

6.1.6 Functional interfaces. Functional interfaces are interfaces which interact across non-material boundaries. Functional interfaces are described in terms of information transfer per the ISO/OSI seven layer model as described.

6.1.7 Inspection. Inspection is a method of verification to determine compliance without the use of special laboratory appliances, procedures, or services, and consists of a non-destructive static-state examination of the hardware, software, and/or the technical data documentation.

6.1.8 Interface. A common functional and/or physical boundary where hardware/software/personnel interact.

6.1.9 Interface Requirements Document (IRD). The IRD is a formal agreement which establishes design requirements for interfaces between subsystems or a subsystem and its supporting facility. The purpose of an IRD is to impose interface design requirements.

6.1.10 NAS Integration verification. This level of verification is conducted at the FAA Technical Center or key site. The verification conducted will determine if the hardware to be deployed for site installation will perform in a National Airspace System (NAS) environment and in accordance with the NAS system level operational and functional requirements.

6.1.11 Parameter values. The establishment of parameter values will be on a site by site basis. The capability shall be provided, however, to vary time delay values in increments and over the range specified in Table 1. The other parameters, i.e., N1, N2, and K are selectable as defined in Table 1.

- T1 Time between the transmission of a frame requiring an acknowledgment and retransmission of the frame in the absence of an acknowledgment. (Distinct values of T1 shall be capable of being specified for different types of frames.)
- T2 Maximum time delay between the receipt of a frame requiring an acknowledgment and transmission of an acknowledging frame. (That is, if in the interval T2, no other frame that can include the acknowledgment is transmitted by the recipient, a special acknowledging frame, e.g., RR, shall be transmitted.)
- N1 Maximum number of bits in an information (I) frame (including LAPB header/trailer (excluding zero insertions for transparency and frame flag sequences)).
- N2 Maximum number of transmissions (original and retransmissions) of a frame requiring an acknowledgment, if no acknowledgment is received.
- T3 The maximum time a link shall be allowed to remain idle (i.e., after an interval of T3 with no traffic on the link, either end shall transmit an RR or other appropriate command requiring a response).
- K Maximum number of outstanding I frames. This value shall be agreed to by both the DTE and the DCE.

6.1.12 Physical interfaces. Physical interfaces are interfaces associated with material contact. Physical interfaces are described in terms of mechanical, electrical/electronic envelope, and environmental characteristics.

6.1.13 Site verification. This level of verification is usually performed at the designated site. The verification portion of the subsystem installation and checkout will emphasize the demonstration to the overall system performance requirements. It includes the demonstration of an end-item, subsystem and system final acceptance demonstrations and commissioning activities.

6.1.14 Subsystem. A grouping of one or more equipment items that is a relatively independent identifiable entity.

6.1.15 Subsystem verification. This level of verification shall be is usually accomplished at the contractor's facility and culminates in the formal acceptance of a contractual end item.

6.1.16 Test. Test is a method of verification wherein performance is measured during or after the controlled application of functional and/or environmental stimuli. Quantitative measurements are analyzed to determine the degree of compliance. The process uses laboratory equipment, procedures, items, and/or services.

6.2 Acronyms and Abbreviations.

The following are acronyms and abbreviations used in this IRD.

ACF	Area Control Facility
cg	Center of Gravity
CCITT	International Telegraph and Telephone Consultative Committee
DCE	Data Circuit Terminating Equipment
DTE	Data Terminal Equipment
EIA	Electronic Industries Association
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FED	Federal
I-frame	Information being transferred
IRD	Interface Requirements Document
ISO	International Organization for Standardization
kb/s	Kilobits per second
LAPB	Link Access Procedures Balanced
LCN	Local Communications Network
MSN	Message Switched Network
NADIN	National Airspace Data Interchange Network
NAS	National Airspace System
NAWPF	National Aviation Weather Processing Facility
OSI	Open Systems Interconnection
PAD	Packet Assembly and Disassembly
PDN	Public Data Network
PSN	Packet Switched Network
PVC	Permanent Virtual Circuit
RDCC	Research and Development Computer Complex
SSCC	System Support Computer Complex
STD	Standard
TRACON	Terminal Radar Approach Control Facility
VC	Virtual Circuit
VRTM	Verification Requirements Traceability Matrix

6.3 Notes

6.3.1 General description of the NADIN Packet Switched Network.

The packet switched network (PSN) complements the existing message switched network to form the National Airspace Interchange Network (NADIN). The PSN provides a service to NAS users by transmitting data between two NAS facilities and in some cases between NAS facilities and external users.

The PSN will provide the following services to users:

- a. Packet switched communications services, based on the 1984 version of CCITT Recommendation X.25.
- b. A gateway between the NADIN PSN and MSN to allow MSN users access to PSN users and visa versa.
- c. Protocol conversion services (PAD's) for users who cannot use the CCITT X.25 protocol.

6.3.2 General Information

In addition to the requirements of this document, most user processors will be required to comply with the requirements of action notice A1830.2, which will be superceded by FAA-STD-029.

